

Science Olympiad - Cobra Invitational - Division B

# Meteorology

February 3rd, 2017

Team name \_\_\_\_\_ **KEY** \_\_\_\_\_ Team # \_\_\_\_\_

## SCORING

Multiple Choice: \_\_\_\_\_ /25

Free Response: \_\_\_\_\_ /25

Tie-breaker #1: \_\_\_\_\_

Tie-breaker #2: \_\_\_\_\_

**TOTAL SCORE**

\_\_\_\_\_ /50

**RANK**

# \_\_\_\_\_

1. Which is the state of the atmosphere at a particular place and time?
  - a. Weather
  - b. Climate
  
2. The principal source of free oxygen in the atmosphere is \_\_\_\_\_.
  - a. Oxidation
  - b. Photosynthesis
  - c. Evaporation
  - d. Ocean offgassing
  
3. The minute liquid and solid particles that are suspended in the atmosphere are known as \_\_\_\_\_.
  - a. Minutia
  - b. Aerosols
  - c. Nuclei
  - d. B and C
  
4. Which of the following is NOT a source for aerosols?
  - a. Volcanic eruptions
  - b. Wind erosion of soil
  - c. Ocean spray
  - d. Evaporation from a lake
  
5. Photochemical smog is classified as a \_\_\_\_\_ air pollutant.
  - a. Primary
  - b. Secondary
  
6. The interaction of the solar wind with the Earth's magnetic field produces the \_\_\_\_\_.
  - a. Magnetosphere
  - b. Ionosphere
  - c. Thermosphere
  
7. Based on the average vertical temperature profile, the atmosphere is divided into four layers. Most weather is confined to the layer called the \_\_\_\_\_.
  - a. Troposphere
  - b. Stratosphere
  - c. Mesosphere
  - d. Thermosphere

8. Which of the following affect climate?
- a. Distance from the equator
  - b. Height above sea level
  - c. The amount of surrounding water
  - d. All of the above
9. Weather DOES NOT include which factor?
- a. Temperature
  - b. Wind speed
  - c. Average amount of sunlight
  - d. All are factors of weather
10. The ultimate source of the energy that drives the atmosphere, produces weather, and is the principal control of climate is the \_\_\_\_\_.
- a. Earth's geothermal heat
  - b. Sun
  - c. Convection current
11. Because of the great differences in their surface temperatures, the sun radiates most intensely in the visible segment of the electromagnetic spectrum, whereas the much cooler Earth radiates most intensely in the \_\_\_\_\_ segment.
- a. Visible
  - b. Infrared
  - c. Ultraviolet
  - d. Radio
12. Assuming no atmospheric effects, the total amount of solar energy received at a particular location on Earth during one daylight period is determined by the length of daylight and \_\_\_\_\_.
- a. Solar altitude (angle of sunlight)
  - b. Varying intensity of the sun
  - c. Both A and B
13. The lower the albedo of a surface, the \_\_\_\_\_ the amount of radiation falling on that surface that is absorbed and converted to heat.
- a. Greater
  - b. Less

14. The most potent greenhouse gas is \_\_\_\_\_. (tie breaker #1)
- a. Carbon dioxide
  - b. Fluorinated gases
  - c. Water vapor
  - d. Ozone
15. Under otherwise clear sky conditions, the lower the amount of water vapor in the air, the \_\_\_\_\_ the overnight low temperature.
- a. Lower
  - b. Higher
  - c. The water vapor does not affect temperature
16. Air is a relatively \_\_\_\_\_ conductor of heat.
- a. Good
  - b. Poor
17. The transfer of heat from Earth's surface is greater over \_\_\_\_\_.
- a. Forests
  - b. Oceans
  - c. Dark mountains
  - d. Light desert
18. Of the following processes, which is the most important for transferring heat in the atmosphere?
- a. Conduction
  - b. Convection
  - c. Radiation
19. The Coriolis Effect causes \_\_\_\_\_.
- a. Global winds and surface currents to move in a straight line
  - b. Global winds and deep ocean currents to move in a curved path
  - c. Global winds and deep ocean currents to move in a straight line
  - d. Global winds and surface currents to move in a curved path
20. How do warm water currents affect the coastal areas along which they flow?
- a. They create greater rainfall along the coast
  - b. They create unusually cool climates for the latitude
  - c. They create unusually warm climates for the latitude
  - d. They make the coastal climate cooler than the inland climate

21. El Niño occurs when tropical ocean waters are warmer in which ocean?

- a. Atlantic
- b. Indian
- c. Pacific
- d. Arctic

22. How does the greenhouse gas effect work?

- a. Greenhouse gases reflect the sun's energy, causing it to warm the Earth.
- b. Greenhouse gases absorb the sun's energy, slowing or preventing heat from escaping into space.
- c. Greenhouse gases directly warm oceans and cause dramatic weather.
- d. Oceans absorb greenhouse gases, which cause the Earth's temperature to rise.

23. What is the biggest source of greenhouse gas emissions in the United States? (tie breaker #2)

- a. Farming, logging and manufacturing
- b. Producing electricity
- c. Heating and cooling buildings
- d. Using transportation

24. Air pressure is \_\_\_\_\_ at the equator and \_\_\_\_\_ at the poles.

- a. Low; high
- b. High; high
- c. High; low
- d. Low; low

25. Colder air sinks because it \_\_\_\_\_ than warmer air.

- a. holds more water
- b. is more dense
- c. is less bouyant
- d. moves slower

**26-28. Label the following as either POSITIVE FEEDBACK or NEGATIVE FEEDBACK.**

26. If the atmosphere warms, the amount of water vapor in the atmosphere will increase (because the saturation vapor pressure goes up). Since water vapor is a greenhouse gas, the added water vapor will make the atmosphere warm even further.

\_\_\_\_\_**POSITIVE FEEDBACK**\_\_\_\_\_

27. Higher amounts of the greenhouse gas CO<sub>2</sub> means that the Earth's surface temperature will increase. These warmer temperatures can extend the growing season for plants, which increases the length of time they can draw CO<sub>2</sub> from the atmosphere. This reduces the amount of atmospheric CO<sub>2</sub>.

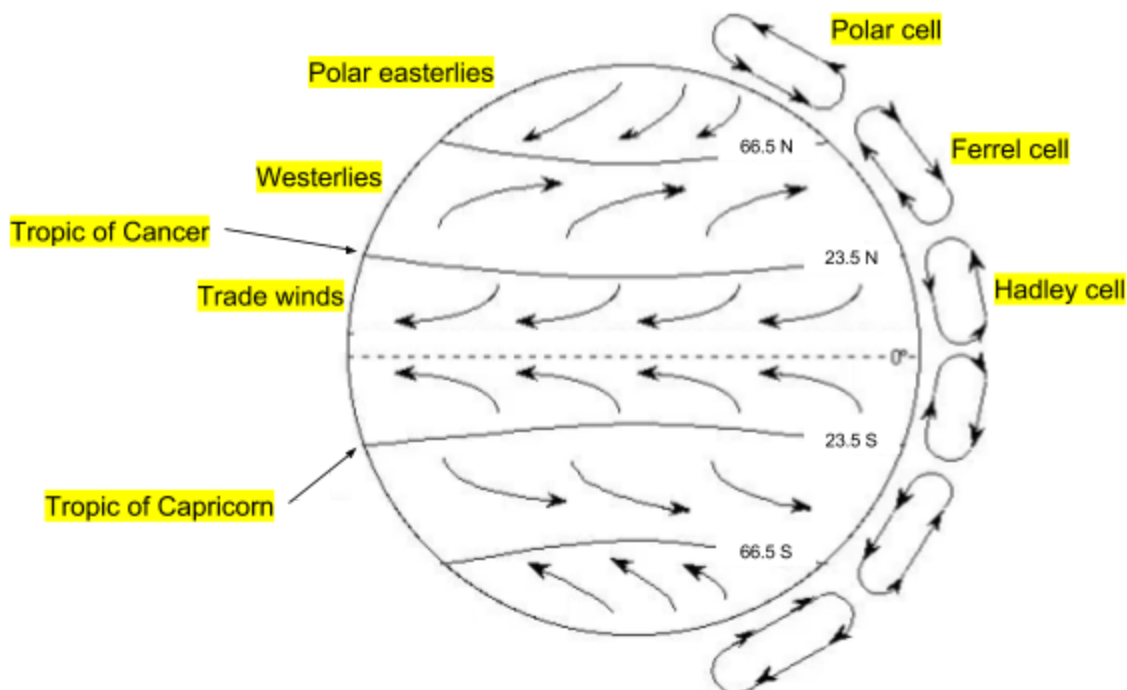
\_\_\_\_\_**NEGATIVE FEEDBACK**\_\_\_\_\_

28. When ice melts, land or liquid water takes its place. Both land and liquid water are less reflective than ice and absorb more solar radiation. This causes more warming, which in turn causes more melting.

\_\_\_\_\_**POSITIVE FEEDBACK**\_\_\_\_\_

**29-37. Label the diagram below using ALL of the words from the word bank. Answer the questions that follow.**

Hadley Cell	Polar Cell	Polar Easterlies	Tropic of Capricorn
Ferrel Cell	Westerlies	Trade winds	Tropic of Cancer



38. At which latitude is the air pressure low? equator and/or 66.5°

39. At which latitude is the air pressure high? poles and/or 23.5°

40-43. Explain the movement of air in a Hadley cell. (3 pts)

Air at the Equator is warmed by direct sunlight and rises. As it rises, it displaces the existing air, pushing it towards the poles. As the air moves toward the poles, it cools and sinks back towards the surface. Once at the surface, it moves toward the equator to take the place of air that is rising, and the cycle starts again.

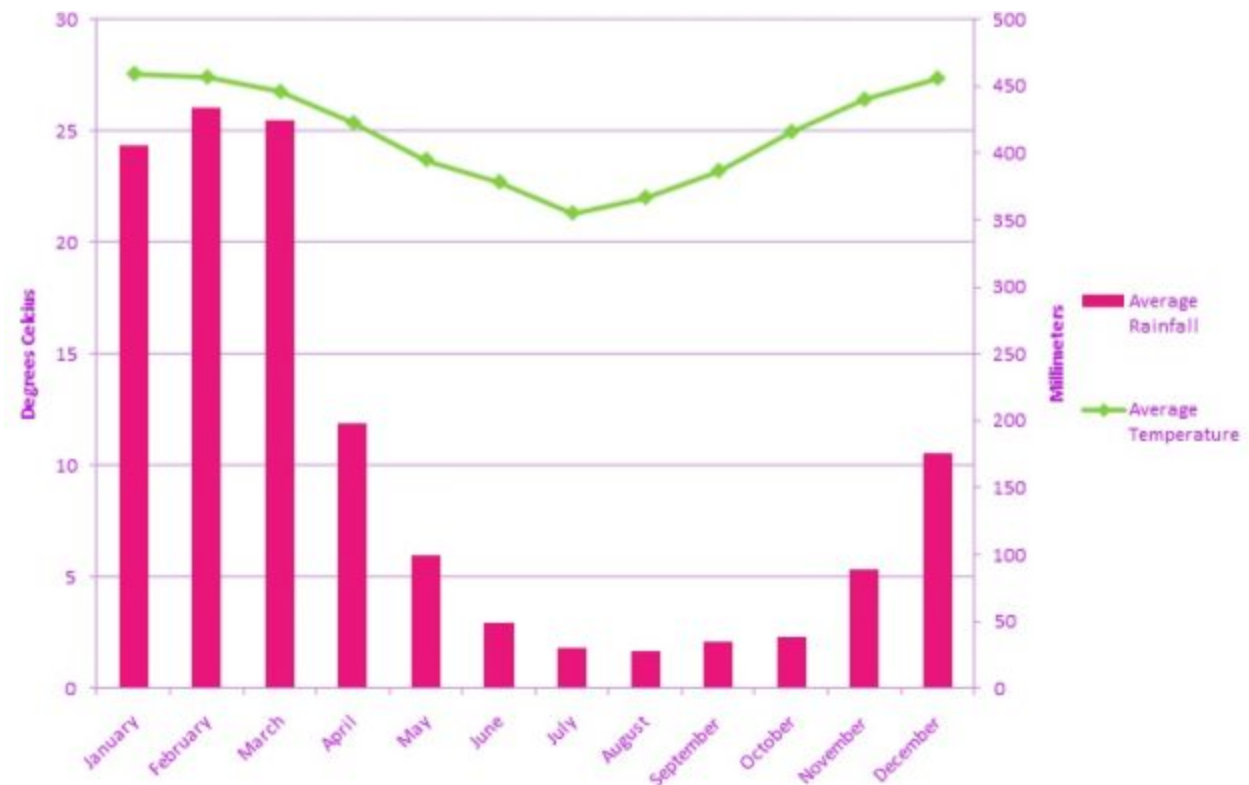
- 1pt - Air rises from equator, moves toward poles, sinks
- 1pt - Air moves as a result of temperature changes, convection
- 1pt - Air is warmed by sunlight; direct at equator, indirect towards poles

The (hypothetical) data below describes a newly discovered island. Use it and the climatograph to answer questions 44-50.

Latitude: 19°S

Longitude: 148°E

Highest point: 1,198 ft



44. What is the average temperature on the island in July?

22°C

45. This island's climate is characterized by a rainy season and a dry season. In which months does the rainy season occur?

January, February, & March

46-47. Explain why our typical summer months (June, July, August) on this island are the coldest months of the year. (2 pts)

This occurs because the island is in the Southern hemisphere. The Southern hemisphere and Northern hemisphere are tilted towards the sun at opposite times of the year. This causes the seasons in each hemisphere to occur in different months.

- 1 pt - Island is in the Southern hemisphere
- 1 pt - Hemispheres are nearer to the Sun at opposite times of year (due to Earth's tilt on axis)

48-50. Which climate zone would we find on this island? Justify your answer using the data above. (3 pts)

This island would most likely be found in the tropical, or tropical savanna, climate zone. The latitude of 19°S places it close to the equator. The climatograph shows warm temperatures that do not change drastically from month to month or with the seasons. The low elevation indicates that the island is not mountainous, and so does not have any of the climate effects of mountainous regions. Finally, there are distinct rainy and dry seasons, characteristic of tropical savanna regions.

- 1pt - Correct climate zone given
- 2pts - At least 2 pieces of evidence given from the data